Memorandum

To: City of Woburn

Date: October 19, 2022

Project #: 15482.00

From: Bill Desantis, PE
Joanna Stowell, PE

Re: Draft Bikeway/Multi-Modal Path Feasibility Study
Woburn, MA

1.1 Project Background

This Feasibility Study includes compiling an existing conditions base map, development of recommendations, evaluation of the anticipated impacts, development of estimated construction costs, anticipated right-of-way/property impacts, and anticipated permitting actions associated with the construction of a shared-use path (SUP) along the former Middlesex Canal/Woburn Branch of the Boston & Lowell Railroad in Woburn, MA. The purpose of this Feasibility Study is to help inform the City's decision on whether to pursue further the right-of-way coordination, design, and construction of a rail-to-trail facility or a practical feasible alternative.

Previous transportation studies in the area include:

- *Woburn Bike Loop Preliminary Plans High Street to Cross Street March 2009* for Woburn Redevelopment Authority
- *Middlesex Canal Segments Alfred Road to School Street* NOI Plans October 2012 for the Middlesex Canal Commission, Northern Middlesex Council of Government dated October 2012.
- *Woburn Bike Loop/Greenway High Street to Cross Street and Arlington Road to Cross Street 25% Plans 2012.*

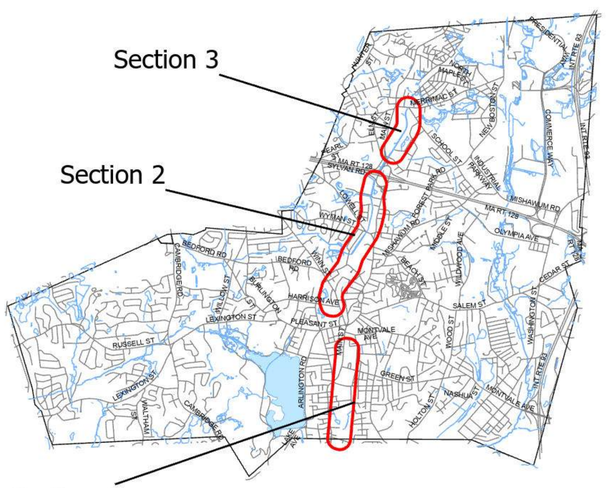
2.1 Project Area Boundaries

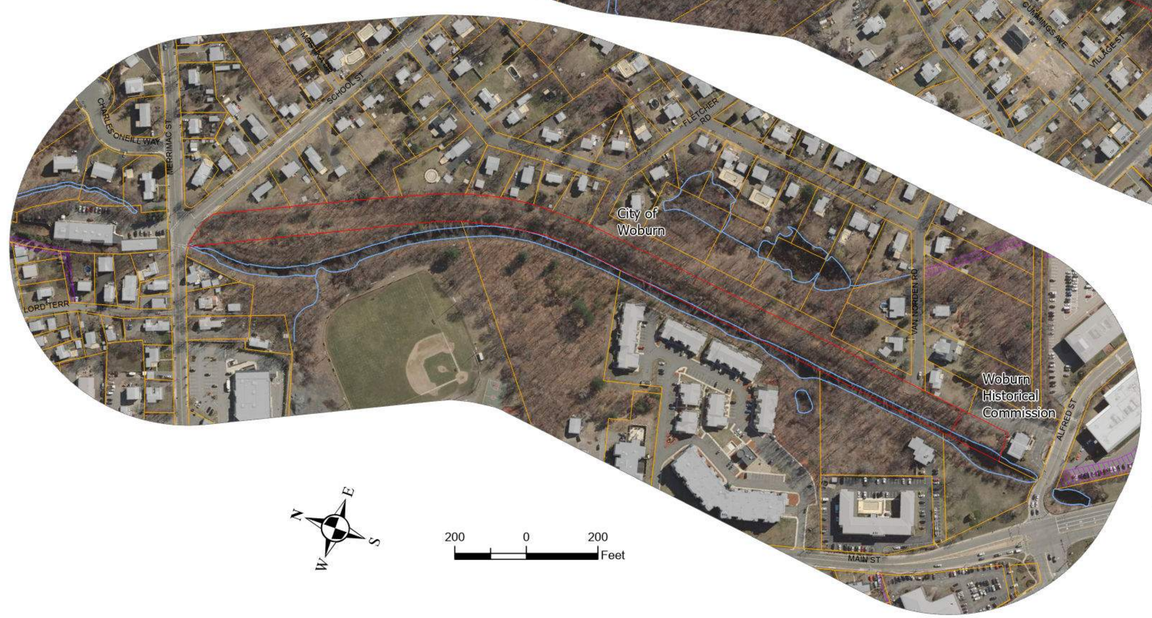
The project corridor is located along the original Middlesex Canal trench and towpath. Major portions of the canal facilities were converted to railroad in the 1800's and 1900's by the former Boston & Lowell Railroad. The proposed trail would be constructed mostly along the former canal towpath and railbed in Woburn.

City of Woburn
Proposed Bikeways

Section 1: Woburn Bike Loop 75% Plans, 2009
Approximately 4,100 feet

Section 2: B&M Railroad Bed
Winn Street to Route 128
No Planning
Approximately 6,000 feet





Section 3: Middlesex Canal Bikeway & Walking Path
Concept Plan 2007
Approximately 2,500 feet

2.2 Project Area General Land Uses

Most of the existing canal and railroad corridor remain physically intact from:

- **Section 1 from Cross Street north to High Street:** This section is owned by the Massachusetts Bay Transportation Authority (MBTA). Adjacent land use is mostly commercial/retail with numerous locations exhibiting temporary non-structure encroachments (material stockpiles, informal vehicle parking lots). There is no evidence of the former canal trench and towpath. The railbed is physically intact however RR infrastructure along this section has been removed. Portions of the corridor are used as an informal pedestrian path. The southern end of Section 1 of the proposed rail trail is in the proximity of the Tri-Community Greenway.
- **Section 2 from Harrison Avenue to I-95/MA 128:** The Canal trench and towpath/railbed are physically intact from Winn Street north to Middlesex Canal Park Drive just south of the I-95 interchange. From Winn Street south to Harrison Avenue and into downtown, the Canal trench, towpath and railbed have been obliterated. It appears the Canal and railbed alignment are now occupied by Abbott Street. From Middlesex Canal Park Drive north to the Alfred Street area north of the I-95/Route 128 interchange, the Middlesex Canal trench does remain; however, the Canal towpath has been obliterated by roadway construction.

  Adjacent land use along the section from Winn Street to Middlesex Canal Park Drive is mostly single family and multi-family dwellings. Except for remnants of the canal trench and towpath/railbed between Winn Street to Middlesex Canal Park Drive, all other canal and railroad infrastructure has been removed. The former canal parcel from Winn Street to Middlesex Canal Park Drive is owned by the Middlesex Canal Association. Portions of this section are used as an informal pedestrian path. There is an informal trailhead connection at the crossing of Middlesex Canal Park Drive.

  The canal trench from I-95/Route 128 south to a point between Lowell Street and Kilby Street is watered by Cummings Brook.
- **Section 3 from Alfred Street to School Street:** The Canal trench, towpath/railbed are mostly intact but other canal and railroad infrastructure has been removed. The right-of-way parcel is owned by the Middlesex Canal Association. Adjacent land use on the east side is single-family residential with City recreational fields and some commercial properties on the west side. A portion of the corridor is currently used as an informal pedestrian path. The section from Alfred Street south to the trailhead on Middlesex Canal Drive has been obliterated by the construction of Main Street and I-95/MA 128 roadways. Connection under I-95/MA 128 presents a significant challenge in its current configuration.

Provisions for trail crossings of project corridor roadways are not currently provided at any crossing roadways.

3.1 Design Policy Related to Bicycle and Pedestrian Accommodation

U.S. Department of Transportation (USDOT) and Massachusetts Department of Transportation (MassDOT) policy is to incorporate safe and convenient walking and bicycling facilities into transportation projects. The USDOT policy states that every transportation agency, including state DOTs, has the responsibility to improve conditions and opportunities for walking and bicycling and to integrate walking and bicycling into their transportation systems. Because of the numerous individual and community benefits that walking and bicycling provide – including health, safety, environmental, transportation, and quality of life – transportation agencies are encouraged to go beyond minimum standards to provide safe and convenient facilities for these modes.

3.2 Definitions of Bikeway Types

The following types of bikeways were considered during the preparation of this memo. These bikeway definitions are taken from the American Association of State Highway and Transportation Officials (AASHTO) *Guide for the Development of Bicycle Facilities*, 2012, Fourth Edition (AASHTO Bike Guide).

Marked Shared Lane - Cambridge, MA

Paved Shoulder - Swansea, MA

Bike Lane – Worcester, MA

Shared Lane Bikeway – Shared lane bikeways are best used on minor local neighborhood streets with low speeds and low traffic volumes where bicycles can share the road without special provisions. Generally, the speed differential between motorists and bicyclists is typically 15 mph or less with motor vehicle speeds of 30 mph or less. Traffic volumes on the roadway are typically less than approximately 1,000 vehicles per day.

Marked Shared Lane Bikeway – Marked shared-lane bikeways are best used on local collectors or minor arterials with narrow travel lanes where bike lanes are not feasible due to narrow lanes, space constraints, and right-of-way limitations. Traffic volumes can be variable, but the motor vehicle speed limit should be 35 mph or less.

Paved Shoulder – Paved shoulders are paved areas adjacent to the roadway travel lanes delineated by a longitudinal pavement marking. Paved shoulder bikeways are best used on rural roadways that connect town centers or other attractions but can be used in urban areas. Traffic volumes can be variable, but the motor vehicle posted speed should be 55 mph or less. The width of the shoulder should be dependent on characteristics of the adjacent motor vehicle traffic (i.e. wider shoulders should be used on higher speed roadways) but a shoulder width of 4 feet is considered the minimum for bicycle travel.

Bike Lane – A bike lane is a portion of a roadway that has been designated for preferential or exclusive use by bicyclists by pavement markings and, if used, signs. Bike lanes can be used on major roads to provide quick and direct bicycle access to the same destinations as motorists. Bike lanes can also be used on collector roads or congested urban streets. Generally, roadway design speeds are more than 25 mph. Traffic volumes can vary as the motor vehicle/bicycle speed differential is generally a more important factor in the decision to provide bike lanes.

Shared-Use Path - Watertown, MA

Shared Use Path/Sidepath – A shared use path (SUP) is a bikeway outside of the roadway traveled way and physically separated from motorized vehicular traffic by a buffer or barrier. The SUP can be either within the roadway right-of-way or on an independent alignment. SUPs are also used by pedestrians, including skaters, wheelchairs users, and joggers/walkers. The types of design criteria for SUPs (design speed, minimum curve radii, stopping sight distance, etc.) are of similar type for design of roadways but modified based on the operating characteristics of a bicycle as a vehicle and a bicyclist as a vehicle operator.

Rail-to-Trail - Mansfield, MA

Rail-to-Trail – A rail-to-trail is a SUP constructed within the remaining bed of a former rail line. Often the rail bed had been constructed by cutting and filling the existing terrain to maintain straight alignment and gentle even grades which is compatible with ADA accessibility requirements.

3.3 Design Criteria

The project criteria have been derived based on standard engineering practice and the successful application of regulatory standards and guidelines. The primary references for the project criteria listed include:

- The American with Disabilities Act (ADA) Design Guidelines for Shared Use Paths;
- The Massachusetts Department of Transportation (MassDOT) *Massachusetts Highway Department Project Development and Design Guide*, 2006 (MassDOT PDDG);
- The Massachusetts Department of Transportation (MassDOT) *Separated Bike Lane Planning and Design Guide*, 2012;
- The American Association of State Highway and Transportation Officials (AASHTO) *Guide for the Development of Bicycle Facilities,* Fourth Edition, 2012 (AASHTO Bike Guide);
- The American Association of State Highway and Transportation Officials (AASHTO) *A Policy on Geometric Design of Highways and Streets*, 2018 (AASHTO Green Book);
- The FHWA *Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations July 2018, Updated;*
- The *Manual on Uniform Traffic Control Devices* (MUTCD) 2009 Edition with revisions and applicable Interim Approvals; and
- Applicable MassDOT Engineering Directives.

4.1 Project Corridor Recommendations

The former canal/railroad corridor can be divided into three distinct sections based on the current condition of the railbed and the ownership of the land parcels.

› **Section 1 – Cross Street to High Street**

Since the existing railbed is mostly physically intact and publicly owned, the most practical and feasible trail alternative would be a rail-to-trail conversion. Preliminary design plans have been previously completed. There do not appear to be significant construction challenges for rail-to-trail conversion in Section 1. Some adjacent businesses are actively encroaching into the right of way, including stockpiles of construction materials and vehicles. Discussions with some of these abutters will be required to resolve the encroachment issues. Others may be occupying the right-of-way with permission of the MBTA. Negotiations with the MBTA will therefore also be required, to determine to what extent lease/use agreements with abutters do exist, how the terms accommodate a shared use path, and the exact mechanism for right-of-way ownership transition such as transfer of ownership to the City or rail baking for potential transit use in the future.

Traffic volumes from record information for Section 1 roadways are shown in the table below:

Traffic Volumes						
	Cross Street	Cranes Court	Conn Street	Fowle Street	Green Street	High Street
AADT	4,254 (2005)	*	*	3,775 (2022)	*	*
Peak Hour Vol.	*	*	*	*	*	*

*Record data not available.

Based on record traffic volume information, enhanced crossing treatments are recommended at the following roadway crossings in Section 1:

STREET	CLASSIFICATION	PROPOSED TREATMENT
• Cross Street	City/Major collector 2 lane/under 30mph	Path starts and ends on north side of Cross Street without connection to another path. No crossing needed.
• Cranes Court	City/Local 2 lane/under 30mph	High-visibility crosswalk markings, parking restrictions on roadway approaches to crosswalk, adequate nighttime lighting levels, and trail crossing warning signs.
• Conn Street	City/Local 2 lane/under 30mph	High-visibility crosswalk markings, parking restrictions on roadway approaches to crosswalk, adequate nighttime lighting levels, and trail crossing warning signs.

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• Fowle Street	City/Local 2 lane/under 30mph	High-visibility crosswalk markings, parking restrictions on roadway approaches to crosswalk, adequate nighttime lighting levels, and trail crossing warning signs.
• Green Street	City/Major collector 2 lane/30mph	High-visibility crosswalk markings, parking restrictions on roadway approaches to crosswalk, adequate nighttime lighting levels, and trail crossing warning signs.
• High Street	City/Local 2 lane/30mph	Proposed path starts/ends before roadway. Use existing crosswalk across High Street at Main Street, install trail crossing warning signs.

› **Section 2 – Harrison Street to Middlesex Canal Park Drive**

Since the existing railbed is mostly physically intact and publicly owned from Winn Street to Middlesex Canal Park Drive, the most practical and feasible trail alternative would be a rail-to-trail conversion. There do not appear to be significant construction challenges for a rail-to-trail conversion in Section 2. Residential abutters may object to a trail at the rear of their property, but many effective and relatively inexpensive options are available (fencing, landscaping, etc.) to address the typical abutter concerns.

Traffic volumes from record information for Section 2 roadways are shown in the table below:

Traffic Volumes					
	Harrison Avenue	Winn Street	Kilby Street	Lowell Street	Middlesex Canal Park Drive
AADT	*	5,402 (2005)	2,230 (2021)	2508 (2021)	1,969 (2020)
Peak Hour Vol.	*	*	*	*	*

*Record data not available.

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Based on record traffic volume information, enhanced crossing treatments are recommended at the following roadway crossings in Section 2:

STREET	CLASSIFICATION	PROPOSED TREATMENT
• Harrison Avenue	City/Local 2 lane/30mph	High-visibility crosswalk markings, parking restrictions on roadway approaches to crosswalk, adequate nighttime lighting levels, and trail crossing warning signs. In street pedestrian crossing signs.
Winn Street	City/Minor Arterial 2 lane/30mph	High-visibility crosswalk markings, parking restrictions on roadway approaches to crosswalk, adequate nighttime lighting levels, and trail crossing warning signs.
• Kilby Street	City/Major Collector 2 lane/under 30mph	High visibility crosswalk markings, parking restrictions on roadway approaches to crosswalk, adequate nighttime lighting levels, and trail crossing warning signs. Advanced yield/stop for pedestrians sign.
• Lowell Street	City/Major Collector 2 lane/30mph	Upgrade to high-visibility crosswalk markings, parking restrictions on roadway approaches to crosswalk, adequate nighttime lighting levels, and trail crossing warning signs. In street pedestrian crossing signs.
• Middlesex Canal Park	Drive – Private/Local 2-3 lane/not posted	High-visibility crosswalk markings, parking restrictions on roadway approaches to crosswalk, adequate nighttime lighting levels, and trail crossing warning signs. In street pedestrian signs. Curb extensions.

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› **Section 3 – Alfred Street to School Street**

Since the existing railbed is mostly physically intact and publicly owned from Alfred Street to School Street, the most practical and feasible trail alternative would be a rail-to-trail conversion. There do not appear to be significant construction challenges for a rail-to-trail conversion in Section 3. Enhanced crossings treatments are recommended at the School Street and Alfred Street access points.

The remaining segment of canal trench in Section 3 is watered by Halls Brook. Since the railbed is located on the east side of the watered canal trench, access to the recreational fields on the west is possible only at the end points of this section. Construction of a bike/pedestrian bridge over the canal trench should be considered to provide access to the recreational fields.

Traffic volumes from record information for Section 3 roadways are shown in the table below:

Traffic Volumes						
	Alfred Street	I-95 NB On-Ramp	I-95 SB Off-Ramp	I-95 SB On-Ramp	I-95 NB Off-Ramp	School Street
AADT	*	*	*	*	*	3,888 (2005)
Peak Hour Vol.	*	*	*	*	*	*

*Record data not available.

Based on record traffic volume information, enhanced crossing treatments are recommended at the following roadway crossings in Section 3:

STREET	CLASSIFICATION	PROPOSED TREATMENT
• Alfred Street	City/ Local	Proposed path starts/ends before roadway. Existing walk across Alfred Street at Main Street.
• School Street	City/Minor arterial 2 lane/under 30mph	Upgrade to high visibility crosswalk markings, parking restrictions on roadway approaches to crosswalk, adequate nighttime lighting levels, and trail crossing warning signs.

4.2 Recommendations for Connecting the Rail-Trail Sections

Based on preliminary evaluation of the existing conditions of the canal and railroad remnants in Woburn, it seems that construction of a rail-to-trail type shared use path on the three sections would not present overly complicated or expensive design, permitting, or construction challenges. There are challenges to connecting the three sections into one continuous off-road shared use path from Cross Street north through downtown Woburn, across I-95/Route 128, up to School Street. The following recommendations should be considered for section connections:

Section 1 (Cross Street to High Street) to Section 2 (Harrison Street to Middlesex Canal Park Drive): The canal towpath and railbed have been obliterated in between these sections. Connecting these sections with an off-road path from the remaining railbed sections would require significant alteration to existing roadways including Harrison Avenue, Abbott Street, Pleasant Street, Common Street, and Main Street/Route 38. These roadways are included in MassDOT Transportation Improvement Program Project ID #610662. In the interim, standard bike route directional signage could be provided to define an on-road bikeway route between Section 1 at High Street to Section 2 at Winn Street.

Section 2 (Winn Street to Middlesex Canal Park Drive) to Section 3 (Alfred Street to School Street): The Canal towpath and railbed have been obliterated between Middlesex Canal Park Drive and Alfred Street by the I-95/Route 128 roadways and interchange. Connecting Sections 2 and 3 would require diverting trail users north along Middlesex Canal Park Drive to Main Street/Route 38 then north along Main Street/Route 38 into the I-95/Route 128 rotary interchange. A road diet may be feasible to provide room for an off-road parallel SUP around the rotary, however path users would still be required to cross the high-volume/high-speed on-ramps and off-ramps to reach Section 3 at Alfred Street. A detailed traffic analysis should be completed to verify that a road diet in the interchange rotary will not impact traffic flow on the I-95/Route 128 on-ramps and off-ramps.

5.1 General Applicable Environmental Guidance

This Feasibility Study was developed using data provided by the Massachusetts Office of Geographic Information (MassGIS). This database is a compilation of information acquired from a broad base of public and private agencies and serves as a useful tool for the purposes of planning and assessing potential suitability of land use and development. The findings below are useful for identifying stakeholders and anticipating permitting requirements for the proposed recommendations. Further research, field verification, and field survey will be needed to verify the findings of this report before proceeding to final design.

5.2 Anticipated Impacts and Criteria

This section describes the anticipated environmental impacts of the proposed SUP and other criteria for evaluation, including:

- Relocation Impacts and Right of Way Acquisition
- Considerations Relating to Pedestrians and Bicyclists
- Air Quality Impacts
- Noise Impacts
- Impacts to Outstanding Resource Water
- Impacts to Wetlands

- Floodplain Impacts
- Impacts to Certified Vernal Pools
- Impacts to NHESP Priority and Estimated Habitats
- Impacts to Areas of Critical Environmental Concern
- Impacts to National Register Historic District and Property
- Wellhead Protection Areas
- Impacts to Hazardous Waste Sites
- Construction Impacts
- Visual Impacts
- Impacts to Public Utilities
- Public Facilities Connections
- Environmental Justice Impacts
- Construction Costs
- Maintenance and Operations

5.2.1 Relocation Impacts and Right-of-Way Acquisition

The proposed shared use path will use publicly owned parcels where possible to minimize the need for right-of-way acquisition. Most of the parcels in the study area are owned by either the City of Woburn, the MBTA, or the Middlesex Canal Association, but there are some locations that will require right-of-way acquisitions or exchanges.

- **Section 1**

  The former railbed in this section is owned by the MBTA. There are a few portions of the former railbed where businesses have encroached on the right-of-way by storing building and landscape materials, supplies, and/or vehicles. The abutter at the end of Cranes Court may have crossing/access rights across the MBTA right-of-way that should be researched and clarified. Between Fowle Street and Green Street there are two landlocked parcels for which an access agreement or right-of-way exchange will need to be negotiated.

  Access to the proposed path at the end of Section 1 will likely be from High Street. A right-of-way exchange may need to be negotiated with the abutter at this point who is either currently encroaching on the MBTA-owned right of way or may have a lease arrangement with them.

- **Section 2**

  There are no anticipated right-of-way issues in this section. The former railbed/canal is owned by the City of Woburn or the Middlesex Canal Association throughout this section.

- **Section 3**

  There is a private parcel with a building at 2 Alfred Road that blocks access from Alfred Road to the City-owned right-of-way adjacent to the canal. While City-owned Kiwanis Park could provide access around the private parcel, a pedestrian bridge would be required to span the canal.

5.2.2 Air Quality Impacts

Air quality in the study area would not be substantially affected by project construction because of the temporary nature of bike path construction.

In the long-term, one positive result of a path project is improvement in air quality by encouraging walking and biking instead of driving. Additionally, providing a designated path for biking and walking that is separated from traffic reduces the traffic-related air pollution.

5.2.3 Noise Impacts

Construction activities would result in a moderate but temporary noise impact at various locations adjacent to proposed construction. Noise levels would vary depending on the type and number of pieces of equipment active at any one time. Noise impacts during construction can be mitigated by limiting the construction time periods.

5.2.4 Impacts to Outstanding Resource Water

Massachusetts Department of Environmental Protection (DEP) has designated certain waters for protection based on their outstanding socio-economic, recreational, ecological and/or aesthetic values.

Based on the MassGIS database, the proposed work impacts a public water supply watershed that is designated as Outstanding Resource Water. Section 1 and Section 2 of the proposed path are entirely within this resource area with the exception of 800 feet at the beginning of Section 1. Given the limited nature of bike path construction and the relatively minor increase in impervious surface, impacts are anticipated to be minimal.

5.2.5 Impacts to Wetlands

Potential impacts to wetlands fall under the jurisdiction of the local Conservation Commission.

Wetlands meeting the regulatory definition are subject to jurisdiction under Sections 401 and 404 of the federal Clean Water Act. All wetland resource areas identified within the project corridor are subject to federal jurisdiction.

Under Section 401, projects which fill less than 5,000 square feet of federally regulated wetlands do not require an individual 401 Water Quality Certification provided that the work is done with a valid Order of Conditions and that 1:1 wetland replication is achieved. Projects filling greater than 5,000 square feet of federally regulated wetlands require an individual Section 401 Water Quality Certification.

Pursuant to Section 404 of the Clean Water Act, the placement of fill material and other alterations within federally regulated wetlands requires authorization from the U.S. Army Corps of Engineers (USACE). Projects filling less than one acre of federal wetlands may be covered under the Massachusetts General Permit (GP). Projects eligible for coverage under the GP may be automatic (non-reporting) if total wetland impacts are less than 5,000 square feet. Projects filling 5,000 square feet to one acre are classified and reviewed by the USACE and other federal agencies to determine if the project meets the conditions of the GP. Alterations to regulated wetlands more than one acre are not eligible for the GP and require an Individual Permit.

Any alteration or work proposed within the state and locally regulated wetlands would be limited to 5,000 square feet of alteration unless the proposed work qualified as a "limited project" (310 CMR 10.53), such as an Ecological Restoration limited project. A Notice of Intent would need to be filed with the Woburn Conservation Commission under the WPA and Bylaw for approval of alteration of a wetland resource area. Any wetland alterations within the project corridor will require 1:1 wetland replication that meets applicable performance standards.

Based on the MassGIS database, the anticipated wetland impacts are as follows:

- Section 1 does not appear to directly impact any wetlands, although this will need to be confirmed via field verification. There are two marsh/bog wetlands adjacent to the MBTA right-of-way in this section between Cross Street and Conn Street, but no wetlands are shown directly in the proposed path in the MassGIS database.
- Section 2 has surface water in the form of the canal in between Kilby Street and the Route 128/95 Rotary. There are anticipated wetland impacts from path construction in this area. In addition to the surface water in this section, there is one marsh/bog wetland that encroaches on the right-of-way just south of the Route 128/95 Rotary.
- Section 3 is similar to Section 2 with the canal surface water and a single wooded marsh wetland encroaching on the right-of-way.

5.2.6 100 Year Floodplain Impacts

Based on the MassGIS database, no portion of the study corridor is within the Federal Emergency Management Agency (FEMA) 100-year floodplain. The local 100-year floodplain does encroach on the corridor where there is open water along Section 2 and Section 3. The most notable area of floodplain impact is in Section 2 just north of Middlesex Canal Park where the entire width of the right-of-way is encompassed within the local 100-year floodplain area.

5.2.7 Certified Vernal Pools

Based on the MassGIS database, the proposed work may impact certified or potential vernal pools as identified by the Massachusetts Natural Heritage and Endangered Species Program (NHESP) as follows:

There are no certified vernal pools within the project corridor. There is one potential vernal pool in Section 3 on the opposite side of the canal from the proposed bike path that is unlikely to be impacted during construction.

5.2.8 NHESP Priority and Estimated Habitat

NHESP maintains a database of the habitats of State-listed rare species in Massachusetts based on observations documented in the last 25 years.

Work will require review under the Massachusetts Endangered Species Act (MESA). The WPA NOI will be reviewed by NHESP to determine if the project needs to be conditioned to avoid impacting rare species.

Based on the MassGIS database 2017 Edition of the Massachusetts Natural Heritage Atlas, there is no NHESP Priority Habitat of Rare Species and Estimated Habitat of Rare Wildlife located within the project limits.

5.2.9 Areas of Critical Environmental Concern

The Secretary of Energy and Environmental Affairs (EEA) has designated places in Massachusetts that receive special recognition because of the quality and significance of their natural and cultural resources. These areas, identified as Areas of Critical Environmental Concern (ACEC), require a stricter environmental review of certain kinds of proposed development administered by the Department of Conservation and Recreation (DCR) on behalf of the EEA.

Based on the MassGIS database, there are no ACECs identified within the project limits.

5.2.10 National Register of Historic Properties and Districts

The historic resources considered in this analysis are those included in the Massachusetts Cultural Resource Information System (MACRIS) maintained by the Massachusetts Historical Commission (MHC). These resources include buildings, burial grounds, structures, and objects as well as areas and districts recognized by the National Register of Historic Places and local historic and preservationist agencies.

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Section 1

The MACRIS database does not indicate any properties in the database within or abutting Section 1.

Section 2

The MACRIS database indicates there are 10 previously surveyed properties comprised of 7 individual properties and 3 areas within or adjacent to the Section 2 project limits.

MHC No.	Property Name	Location	NR Status	Within or Adjacent to Project Limits
WOB.D	Middlesex Canal Area	-	-	Within
WOB.F	Woburn Public Library	-	NRIND; NHL	Adjacent
WOB.J	Middlesex Canal Historic and Archaeological	-	NRDIS	Within
WOB.6	Woburn Public Library	45 Pleasant Street	NRIND; NHL	Adjacent
WOB.13	Thompson, Leonard House	11 Lowell Street	NRDIS	Adjacent
WOB.14	Guastavino, R. Ceramic Tile Factory and Showroom	660 Main Street	-	Adjacent
WOB.15	U.S. Post Office – Woburn Center Station	1 Abbot Street 4 Federal Street	NRIND	Adjacent
WOB.274	-	2 Middlesex Street	NRDIS	Adjacent
WOB.275	-	100 Winn Street	NRDIS	Adjacent
WOB.906	Count Rumford Statue	45 Pleasant Street	NRIND; NHL	Adjacent

NHL National Historic Landmark
NRDIS National Register Historic District
NRIND Property Individually Listed in the National Register

Section 3

The MACRIS database indicates there are seven previously surveyed properties comprised of two individual properties and five areas within or adjacent to the Section 3 project limits.

MHC No.	Property Name	Location	NR Status	Within or Adjacent to Project Limits
WOB.B	Middlesex Canal	-	NRDIS	Within
WOB.D	Middlesex Canal Area	-	-	Within
WOB.H	Baldwin Homestead Historic District	-	LHD; NRDIS	Within
WOB.J	Middlesex Canal Historic and Archaeological	-	NRDIS	Within
WOB.1	Baldwin, Loammi Mansion	2 Alfred Street	LHD; NRDIS; NRIND	Within
WOB.12	North Congregational Parish Church	827 Main Street	NRIND; LHD; NRDIS	Adjacent
WOB.945	Middlesex Canal	-		Within

LHD Local Historic District
NRDIS National Register Historic District
NRIND Property Individually Listed in the National Register

5.2.11 MassDEP Approved Wellhead Protection Area (Zone I and Zone II)

Wellhead protection areas are important for protecting the recharge area around public water supply (PWS) groundwater sources.

A Zone I is the area closest to the well and is a defined protective radius needed around a public water supply (PWS) well or wellfield. The PWS groundwater source locations are buffered to produce the Zone I area. Buffer radii values are determined from pumping rate information as provided by the MassDEP DWP and vary between 100'-400'.

A Zone II is a wellhead protection area that has been determined by hydro-geologic modeling and approved by the DEP's Drinking Water Program (DWP). A Zone II classification is that area of an aquifer which contributes water to a well under the most severe pumping and recharge conditions that can be realistically anticipated (180 days of pumping at approved yield, with no recharge from precipitation).

Based on the MassGIS database, no portions of the proposed alignment are located near a Zone I Approved Wellhead Protection Area, but portions of Section 1 and Section 2 are located within a Zone II Approved Wellhead Protection Area. Impacts to wellhead protection zones are not anticipated.

5.2.12 Hazardous Materials Sites

The design of the bikeway along the former rail bed will be in accordance with the Massachusetts Department of Environmental Protection's (MassDEP) *Best Management Practices for Controlling Exposure to Soil during the Development of Rail Trails*. For purposes of this feasibility study, it is assumed that remediation of any contaminated soils along the rail bed will be addressed by capping the existing soils in place as described in the MassDEP Best Management Practices.

5.2.13 Construction Impacts

Construction of the project will result in temporary disruption to allow construction vehicles to access the work area. Depending on which alternative is selected, temporary construction access to and from the project corridor from local roadways will be required. Appropriate temporary traffic controls (TTC) will be required in the form of construction signing and temporary markings. Typical Traffic Management Plans (TMP) should be developed and included in the construction documents for construction access to/from these roadways.

5.2.14 Visual Impacts

The project proposes to construct a path along existing railbed. The extent of additional clearing and grading will be minimal since the railbed currently hosts trail activities such as walking, hiking and mountain biking. The visual impact may be beneficial as it will remove invasive plant species and some trash/debris from the former railbed.

5.2.15 Public Utilities

- Section 1: A 60" reinforced concrete drainage line and a 15" vitrified clay sewer line run within the right-of-way for the majority of Section 1. Coordination will be required to protect the sewer and drainage systems during construction and maintenance access will need to be considered during the design phase.
- Section 2: There are a number of drainage system outfalls in Section 2 of the corridor between Middlesex Canal Park and Lowell Street. There is an 8" sewer main that runs parallel to the right-of-way for approximately 330' south of Lowell Street and a 30" sewer main within the right-of-way for approximately 500' north of Kilby Street. The 30" sewer main continues within the right-of-way until Harrison Avenue. There is drainage infrastructure, including a 12" reinforced concrete trunk line, within Abbott Street. Coordination will be required to protect the sewer and drainage systems during construction and maintenance access will need to be considered during the design phase.
- Section 3: There are no public utilities that run through this Section 3 of the corridor. Minor drainage modifications may be required at the ends of the path at School Street and Alfred Street.

5.2.16 Public Facilities

The proposed shared use path will provide connectivity between a variety of locations along the former railbed. The path will run behind or adjacent to many businesses along Main Street in Section 1, pass near Library Park and the Police Station in Section 2, and connect Kiwanis Park to Ferullo Field and the Woburn Dog Park in Section 3.

5.2.17 Environmental Justice

According to the MassGIS database, the project is not located within an area identified as an Environmental Justice Zone.

5.2.18 Construction Cost

The estimated construction costs for the shared use path are summarized below:

- **Section 1 –** $860,000
- **Section 2 –** $1,643,000
- **Section 3 –** $1,487,500
- **Total Cost** – $3,990,500

  SAY: $4,000,000

Refer to the Appendix for a detailed cost estimate breakdown including contingencies and design costs.

5.2.19 Maintenance and Operations

Maintenance

Basic maintenance activities include keeping the trail surface free of debris, identifying and correcting surface hazards, keeping signs and pavement markings in good condition, and cutting back encroaching vegetation to maintain adequate sight distances on the path and at road crossings. Having a written operations and maintenance plan and an emergency response plan will also enable City officials to determine manpower and budgets needed to implement these plans.

We recommend coordination with the Department of Public Works and the Recreation Department regarding access and maintenance so that their recommendations can be incorporated into the project design.

Operations

The goal of this project is a continuous facility for non-motorized travel suitable for use by both bicyclists and pedestrians. The recommendations presented comply with accepted industry standards and criteria for a SUP and encourage users to comply with uniform traffic operations and laws. The signs, pavement markings, and other amenities should be designed to convey that message using common standards of color, shape, and graphics as used on typical roadway signs without "over-signing" the natural landscape.

It is recommended that "trail use rules" be posted at trail access points, as appropriate.

It is also recommended that the City review their existing by-laws as they relate to trails and shared-use facilities to verify if changes or additions are needed.

6.1 Conclusion

Based on preliminary evaluation of the existing conditions of the canal and railroad remnants in Woburn, it seems that construction of a rail-to-trail type shared use path on the three sections would not present overly complicated or expensive design, permitting, or construction challenges. Negotiations with the abutters and MBTA will be required to resolve the encroachment and right-of-way issues in Section 1. In Section 2, residential abutters may object to a trail at the rear of their property, but many effective and relatively inexpensive options are available (fencing, landscaping, etc.) to address the typical abutter concerns.

Connecting the three sections of the path to achieve a continuous route will be difficult given the current constraints, but coordination with MassDOT on TIP project #610662 at Woburn Center to ensure adequate bike facilities are being proposed will be helpful. Additional discussion with MassDOT regarding the Route I-95/Route 128 rotary interchange and a traffic study in the area are recommended next steps.

Action Items

We recommend the City complete the following action items:

- Conduct a joint working meeting with Woburn Police, Fire Department, Public Works, and Recreation Departments to discuss enforcement, emergency response, and maintenance of the shared use path.
- Meet with representatives from MassDOT to discuss the on-road bike facilities that will be part of TIP project #610662.
- Confirm any and all land leases the MBTA may have entered into with abutters, particularly in section 1.
- Submit this draft memorandum for public review and comment

Memorandum

APPENDICES

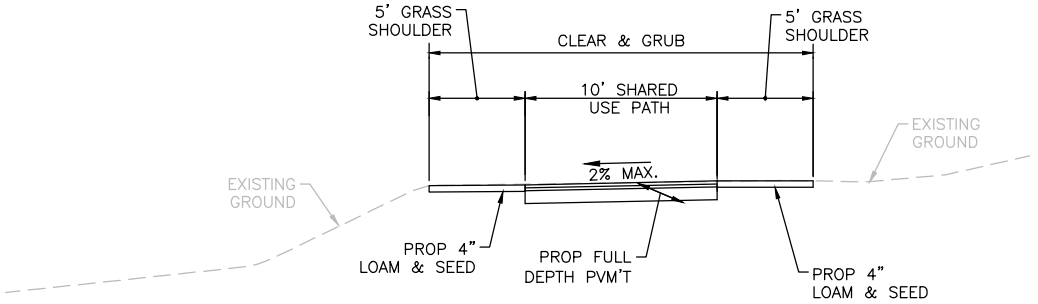
Cost Estimate
Typical Sections
STEP Guide Table 1

Woburn Bike Path - Woburn, MA
Preliminary Construction Cost Estimate - June 2022

	Existing Feature	Proposed Treatment	Length	Approx. Cost (per ft)	Estimated Construction Cost	Notes
Section 1	Dirt path/wooded area/parking lot along existing ROW corridor	Off-Road Shared Use Path	4,250	$200.00	$850,000.00	
	Green Street Crossing	High-Vis crosswalk and signage			$2,500.00	
	Fowle Street Crossing	High-Vis crosswalk and signage			$2,500.00	
	Conn Street Crossing	High-Vis crosswalk and signage			$2,500.00	
	Cranes Court Crossing	High-Vis crosswalk and signage			$2,500.00	
				Subtotal 1:	$860,000.00	
Section 2	Dirt path/wooded area along existing ROW corridor	Off-Road Shared Use Path	5,500	$200.00	$1,100,000.00	
	Private road/parking lot along existing ROW corridor	On-Road Shared Use Path	1,900	$250.00	$475,000.00	
	Middlesex Canal Park Drive Crossing	High-Vis crosswalk and signage			$2,500.00	
	Lowell Street Crossing	Rapid Rectangular Flashing Beacon (RRFB) or High-Intensity Activated Crosswalk Beacon (HAWK)			$30,000.00	
	Kilby Street Crossing	High-Vis crosswalk and advanced crossing warning signs			$3,000.00	
	Winn Street Crossing	Rapid Rectangular Flashing Beacon (RRFB) or High-Intensity Activated Crosswalk Beacon (HAWK)			$30,000.00	
	Harrison Avenue Crossing	High-Vis crosswalk and signage			$2,500.00	
				Subtotal 2:	$1,643,000.00	
Section 3	Dirt path along existing ROW corridor	Off-Road Shared Use Path	2,550	$200.00	$510,000.00	
	School Street Crossing	High-Vis crosswalk and signage			$2,500.00	
	Canal crossing	Bike/Pedestrian Bridge	150	$5,500.00	$825,000.00	
		Utility Modifications			$150,000.00	
				Subtotal 3:	$1,487,500.00	
Miles:	2.72	**Linear Feet:**	14,350	**Subtotal (All Sections):**	**$3,990,500.00**	

Additional Notes:
- Assume 10-foot path for trail with 5-foot shoulders where possible.
- Right-of-way acquisitions and easements are not included.
- Assumes that wayfinding signage, benches, and other amenities are covered under contingencies.
- No major lookout or hardscape features anticipated.
- No path/street lighting included.

Total Projected Costs:	
Subtotal (from above):	$3,990,500.00
Traffic Management 1%	$39,905.00
Mobilization 3%	$119,715.00
Police Details 3%	$119,715.00
Construction Oversight 10%	$399,050.00
Construction Contingency 10%	$399,050.00
Construction Subtotal	**$5,067,935.00**
Inflation (3%/year over 5 years)	$807,190.66
Construction Total	$5,875,125.66
CONSTRUCTION TOTAL	**$5,900,000.00**
Design Fee (15% of subtotal before contingencies)	$598,575.00
DESIGN TOTAL	**$600,000.00**
PROJECT TOTAL	**$6,500,000.00**

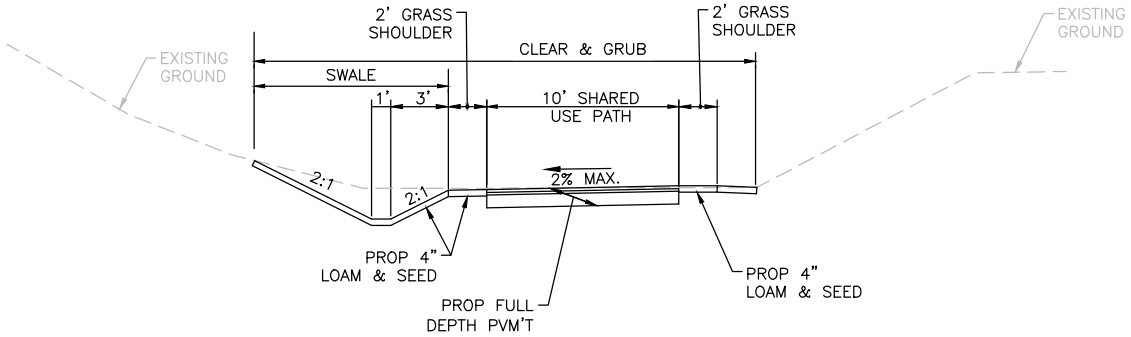


PROPOSED FILL SECTION

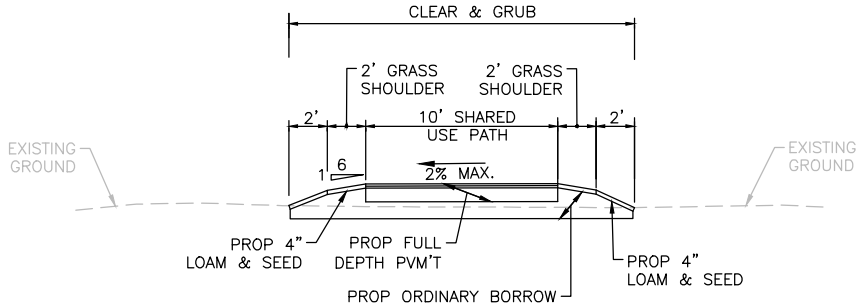
PAVEMENT NOTES:

PROPOSED FULL DEPTH PAVEMENT
SURFACE: 1–3/4" SUPERPAVE SURFACE COURSE 12.5 (SSC–12.5) OVER 2–1/4" SUPERPAVE INTERMEDIATE COURSE 19.0 (SIC–19.0) OVER

SUBBASE: 8" GRAVEL BORROW, TYPE b



PROPOSED CUT SECTION



PROPOSED BUILT–UP SECTION

Typical Sections
Woburn Bike Path
City of Woburn, MA

Table 1 provides initial countermeasure options for various roadway conditions. Each matrix cell indicates possibilities that may be appropriate for designated pedestrian crossings. Not all of the countermeasures listed in the matrix cell should necessarily be installed at a crossing.

For multi-lane roadway crossings with vehicle AADTs exceeding 10,000, a marked crosswalk alone is typically insufficient (Zegeer, 2005). Under such conditions, more substantial crossing improvements (such as the refuge island, PHB, and RRFB) are also needed to prevent an increase in pedestrian crash potential.

Table 1. Application of pedestrian crash countermeasures by roadway feature.

Roadway Configuration	Posted Speed Limit and AADT								
	Vehicle AADT <9,000			Vehicle AADT 9,000–15,000			Vehicle AADT >15,000		
	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph
2 lanes (1 lane in each direction)	❶ 2 4 5 6	❶ 5 6 7 9	① 5 6 ❼ ❾	❶ 4 5 6	❶ 5 6 7 9	① 5 6 ❼ ❾	❶ 4 5 6 7 9	① 5 6 7 9	① 5 6 ❾
3 lanes with raised median (1 lane in each direction)	❶ 2 3 4 5 7 9	❶ ❸ 5 7 9	① ❸ 5 ❼ ❾	① 3 4 5 7 9	① ❸ 5 ❼ ❾	① ❸ 5 ❼ ❾	① ❸ 4 5 7 9	① ❸ 5 ❼ ❾	① ❸ 5 ❾
3 lanes w/o raised median (1 lane in each direction with a two-way left-turn lane)	❶ 2 3 4 5 6 7 9	❶ ❸ 5 6 7 9	① ❸ 5 6 ❾	① 3 4 5 6 7 9	① ❸ 5 6 ❼ ❾	① ❸ 5 6 ❾	① ❸ 4 5 6 7 9	① ❸ 5 6 ❾	① ❸ 5 6 ❾
4+ lanes with raised median (2 or more lanes in each direction)	❶ ❸ 5 7 8 9	❶ ❸ 5 7 8 9	① ❸ 5 8 ❾	① ❸ 5 7 8 9	① ❸ 5 ❼ 8 9	① ❸ 5 8 ❾	① ❸ 5 ❼ 8 9	① ❸ 5 8 ❾	① ❸ 5 8 ❾
4+ lanes w/o raised median (2 or more lanes in each direction)	❶ ❸ 5 6 7 8 9	① ❸ 5 ❻ 7 8 9	① ❸ 5 ❻ 8 ❾	① ❸ 5 ❻ 7 8 9	① ❸ 5 ❻ ❼ 8 9	① ❸ 5 ❻ 8 ❾	① ❸ 5 ❻ ❼ 8 9	① ❸ 5 ❻ 8 ❾	① ❸ 5 ❻ 8 ❾

Given the set of conditions in a cell,

- # Signifies that the countermeasure is a candidate treatment at a marked uncontrolled crossing location.
- ● Signifies that the countermeasure should always be considered, but not mandated or required, based upon engineering judgment at a marked uncontrolled crossing location.
- ○ Signifies that crosswalk visibility enhancements should always occur in conjunction with other identified countermeasures.*

The absence of a number signifies that the countermeasure is generally not an appropriate treatment, but exceptions may be considered following engineering judgment.

1 High-visibility crosswalk markings, parking restrictions on crosswalk approach, adequate nighttime lighting levels, and crossing warning signs
2 Raised crosswalk
3 Advance Yield Here To (Stop Here For) Pedestrians sign and yield (stop) line
4 In-Street Pedestrian Crossing sign
5 Curb extension
6 Pedestrian refuge island
7 Rectangular Rapid-Flashing Beacon (RRFB)**
8 Road Diet
9 Pedestrian Hybrid Beacon (PHB)**

**Refer to Chapter 4, 'Using Table 1 and Table 2 to Select Countermeasures,' for more information about using multiple countermeasures.*

***It should be noted that the PHB and RRFB are not both installed at the same crossing location.*

This table was developed using information from: Zegeer, C.V., J.R. Stewart, H.H. Huang, P.A. Lagerwey, J. Feaganes, and B.J. Campbell. (2005). Safety effects of marked versus unmarked crosswalks at uncontrolled locations: Final report and recommended guidelines. FHWA, No. FHWA-HRT-04-100, Washington, D.C.; FHWA. Manual on Uniform Traffic Control Devices, 2009 Edition. (revised 2012). Chapter 4F, Pedestrian Hybrid Beacons. FHWA, Washington, D.C.; FHWA. Crash Modification Factors (CMF) Clearinghouse. http://www.cmfclearinghouse.org/; FHWA. Pedestrian Safety Guide and Countermeasure Selection System (PEDSAFE). http://www.pedbikesafe.org/PEDSAFE/; Zegeer, C., R. Srinivasan, B. Lan, D. Carter, S. Smith, C. Sundstrom, N.J. Thirsk, J. Zegeer, C. Lyon, E. Ferguson, and R. Van Houten. (2017). NCHRP Report 841: Development of Crash Modification Factors for Uncontrolled Pedestrian Crossing Treatments. Transportation Research Board, Washington, D.C.; Thomas, Thirsk, and Zegeer. (2016). NCHRP Synthesis 498: Application of Pedestrian Crossing Treatments for Streets and Highways. Transportation Research Board, Washington, D.C.; and personal interviews with selected pedestrian safety practitioners.